ON A *GALAXIAS* FROM MOUNT KOSCIUSKO

By J. Douglas Ogilby.

At the meeting of this Society in March, 1882 (Vol. vii. p. 107) the late Sir William Macleay read a paper descriptive of a species of *Galaxias* which had been forwarded to him by Baron von Mueller to whom examples had been sent by Mr. S. Findlay, who found them inhabiting the streams which drain the southern slopes of Mount Kosciusko and form a section of the watershed of the Snowy River; for this form he proposed, at the request of Baron von Mueller, the name of *Galaxias findlayi* in honour of its discoverer and collector.

With the exception of its inclusion in the "Supplement" to Macleay's "Descriptive Catalogue of Australian Fishes" there does not appear to be any further published information respecting the Kosciusko Galaxiid, nor do any specimens from that district seem to have been collected until the autumn of 1889, when a few examples were secured and brought to Sydney by Mr. Richard Helms on the occasion of his visit to that mountain, a short account of which is published in the Records of the Australian Museum, Vol. i. pp. 11-16. These specimens were also obtained from streams flowing into the Snowy River, and writing of their distribution Mr. Helms observes (p. 13):—"The absence of *Galaxias* at this elevation" (Wilkinson's Valley) "struck me as peculiar. It is, however, remarkable that on the Snowy River side these fishes are met with almost everywhere."

The paragraph from which this quotation is taken is not clear, but the most reasonable deduction from it is that, in Mr. Helms' opinion, Galaxiids were scarce or even absent on the Murrumbidgee slope.

Pressure of business prevented a full examination of these specimens being made at the time, and they were put on one side and neglected until the commencement of the current year, when Mr. Helms requested me to furnish him with a report on these fishes, and it was then discovered that owing to the changes

which had taken place in the Museum and the consequent shifting of specimens from place to place the examples in question were not immediately forthcoming.

In default of these the next best thing to do was to endeavour to get other specimens from the same locality, and an opportunity for effecting this occurred through the visit in January last of the Rev. J. M. Curran and Mr. C. Hedley to Mount Kosciusko, and the writer thereupon called the attention of the latter gentleman to the subject in the hope of procuring a good working series for examination; however, the specimens thus obtained, two or three in number, were, on Mr. Hedley's return, handed to the authorities of the Australian Museum, and became, therefore, unavailable for the purpose required, which included such an exhaustive examination as the difficulty of determining the species of this intricate genus and the interest attaching to this particular form as an inhabitant of a greater altitude than is reached by any other Australian fish warranted.

In this unsatisfactory state our knowledge must again have been indefinitely left but that, the Rev. Mr. Curran having occasion to return almost immediately to Kosciusko, the writer took advantage of his going to request him to collect sufficient material to enable the complete examination which was deemed necessary to be made. So well was this request acceded to that on the return of that gentleman from his second trip I received a fine series numbering no less than sixteen individuals in perfect condition, and this collection was afterwards supplemented by a further contribution of eleven, and I take this opportunity of acknowledging my obligations and tendering my grateful thanks to that gentleman for the trouble which he took in procuring so fine a series of specimens.

A critical investigation of these examples reveals facts which greatly invalidate certain apparently well established characters which have hitherto been considered of sufficient importance to justify specific separation. As an instance, it will be remembered that the fishes of the genus *Galaxias* have naturally fallen into two groups, characterised—the one by a short, stout body, of

which group *truttaceus* may be taken as typical, the other by a long, slender body, to which *attenuatus* and its allies are to be referred; yet in this one small species I am confronted with individuals varying from one-fifth to one-eighth in the proportionate measurement of depth to length, and with a corresponding difference in colour from a dull dark brown without or with but very slight indications of markings to bright golden beautifully blotched, spotted, or barred with black. These differences, however, great as they appear to a casual glance, are entirely attributable to the nature of the locality and the water which the individual fish inhabits, the stout, sombre-coloured form being found in the deep still pools and small subalpine tarns, the slender brilliant one in the more rapid gravelly or sandy shallows where it is exposed to the sunlight; but between these two limital forms every conceivable variation, both of contour and colour, may be found.

The distribution of *Galaxias*, comprising as it does the southern extremities of the three great continental areas which converge upon the Antarctic Circle, is unique among fishes, though the Marsipobranchians, of the genera *Geotria* and *Caragola* and the recent members of the clupeoid genus *Diplomystus** somewhat

* The genus *Diplomystus* was instituted by Prof. Cope (Bull. U.S. Geol. Survey Terr. 1877, p. 808) for the accommodation of certain fossil forms of Tertiary Clupeids from the Green River portion of the Wasatch Beds, which are situated in the central region of the United States, where it is numerous both in species and individuals. Three recent species are known, two of which—*norœ hollandiæ* and *sprattellides*—belong to the fauna of south-eastern Australia, and the third (*Clupea notacanthus*, Günth.), to that of Chile. Not being aware of its earlier severance by Cope, I proposed (Records Austr. Mus. ii. p. 24, 1892) to separate, under the name *Hyperlophus*, all those Herrings in which a predorsal serrature was present, but, my attention being kindly drawn thereto by Dr. Smith Woodward, I used Cope's name for Valenciennes' *Meletta novæ-hollandiæ* in a subsequent work (Edible Fish. and Crust. N.S Wales, p. 184, 1893). At present, however, I am uncertain whether *Diplomystus* can properly be retained for these forms, as Dr. Eigenmann in 1891 diagnosed the family *Diplomystidæ*—of which presumably the central genus is *Diplomystus*—for certain South American Nematognaths, and I have not as yet been able to learn the date of this genus; if, however, it is prior to Cope's the clupeoid fishes must take the name *Hyperlophus*.

closely approach it, but in other biological Classes a much more intimate geographical relationship between these Regions may be discerned.*

Several theories have been enunciated to account for this singular distribution of a family of fresh-water fishes in such widely separated regions as western South America, south-eastern Australia, and South Africa. Apparently the most favoured of these theories, as it is also the most natural and the most strongly supported by recent facts, is that, at some remote period of the world's history, there existed a great austral continent, which has now largely disappeared beneath the surface of the ocean and which extended northwards on the one hand through Tierra del Fuego to the southern and south-western parts of South America, on the other through Tasmania to south-eastern Australia, and possibly also to New Zealand and South Africa.

So far as Australia and America are concerned I see no reason to doubt that they were at one time connected at their southern extremities by a belt of land stretching across the south pole, and that the antarctic continent so formed enjoyed a mild and equable climate, and supported a large and varied flora and fauna, the remains of which are abundantly visible in both to the present day, but especially in Australia, where forms of animal life, elsewhere extinct or nearly so, still constitute characteristic features in the faunic aspect, among which may be mentioned the *Marsupialia* among Mammals, the Struthionids among Birds, certain Lizards such as *Chlamydosaurus*, and Fishes such as *Neoceratodus*.

With regard to the claims of New Zealand and South Africa to a post-mesozoic junction with Antarctica the testimony is by no means so convincing, in fact the weight of evidence clearly points to the conclusion that at no more recent time was there any intimate connection between them, while there are many indications that the distance separating them was not so wide as

* For references see Hedley, Proc. Roy. Soc. N.S. Wales, 1895, p. 3, note 1.

to preclude the possibility of many plants and animals finding their way across "either by flight or drift."*

In the case of *Galaxias* the ova might easily have been carried across on the feet or plumage of water-birds, or, as seems to me a more simple and natural solution, some individuals having been swept out to sea by floods in their native rivers, have survived the passage across the intervening belt of ocean and successfully colonised the shores to which they wandered.†

Galaxias findlayi.

Galaxias findlayi, Macleay, Proc. Linn. Soc. N. S. Wales, 1882, vii. p. 107.

B. ix. D. 12-13. A. 11-12.‡ V. 9. P. 16. C. 16. Vert. 37-38 23.

Body stout to slender, the head broad and depressed. Length of head $4\frac{3}{4}$ to $5\frac{1}{2}$, depth of body $5\frac{1}{5}$ to 8 in the total length; width of body equal to or a little less than its depth, $1\frac{1}{5}$ to $1\frac{3}{4}$, of interorbital region $2\frac{1}{5}$ to $3\frac{1}{5}$, diameter of eye 4 to $5\frac{2}{5}$ in the length of the head; snouth obtuse, from three-eights to three-fourths of a diameter longer than the eye, which is very small. Lips thick and fleshy; the maxillary reaches to the vertical from the middle of the eye or not quite so far; lower jaw included. Seven or eight gill-rakers on the lower branch of the anterior arch. Jaws with a single series of moderate hooked teeth of somewhat irregular size; palatines with a similar series along their inner border directed inwards and backwards; a series of five strong hooked teeth on each side of the tongue and a single median tooth in front; vomer toothless. Dorsal fin obtusely pointed or rounded,§

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* Hedley, l.c. p. 6.

† For an analogous example of colonization see Ogilby, Proc. Roy. Dublin Soc. 1885, p. 529, re *Coregonus pollan*.

‡ The small rod-like rays in front being variable in number are not included, the computation being made from the first normally articulated ray.

§ In the largest example all the fins are rounded except the caudal.

the space between its origin and the base of the caudal $2\frac{2}{3}$ to $2\frac{3}{4}$ in its distance from the extremity of the snout; the fourth and fifth rays are the longest, $1\frac{4}{5}$ to 2 in the length of the head; the base of the fin is $1\frac{1}{10}$ to $1\frac{1}{5}$ in its height and $1\frac{1}{2}$ to $1\frac{3}{5}$ in the space between its origin and that of the anal: the anal fin is similar in shape to and originates beneath the last fourth of the dorsal; the fifth and sixth rays are the longest, as long as or a little longer than the dorsal rays; its base is $1\frac{1}{10}$ to $1\frac{1}{5}$ in its height, and 1 to $1\frac{1}{4}$ in its distance from the caudal: ventral inserted nearer to the anal than to the base of the pectoral, not reaching to beneath the dorsal fin; the distance between its origin and the base of the caudal is $1\frac{1}{10}$ to $1\frac{1}{4}$ in its distance from the tip of the snout; the middle rays are the longest, $1\frac{1}{2}$ to $1\frac{3}{4}$ in the length of the head and 2 to $2\frac{1}{4}$ in the distance between its origin and the anal: pectoral cuneiform, $1\frac{1}{5}$ to $1\frac{1}{2}$ in the head and $2\frac{1}{8}$ to $2\frac{2}{3}$ in the space between its origin and the ventral: caudal slightly emarginate with the lobes rounded, $1\frac{1}{5}$ to $1\frac{1}{3}$ in the length of the head, the peduncle rather slender and compressed, its depth $2\frac{2}{3}$ to $3\frac{1}{5}$ in its length.

Colours variable: from dark greenish-brown above and yellowish-brown below, the sides with more or less distinct darker markings, which may take the form of irregular transverse bands, or of minute spots, which again may be concurrent so as to form blotches or may be distributed so as to almost obliterate the ground-colour, generally with a more or less well defined series of dark spots along the middle of the body, with the fins shading from yellowish-brown basally to orange distally; to golden with regular transverse bands or large blotches of a black or dark chestnut colour, with the fins yellow. Irides silvery.

In addition to the above, the Rev. Mr. Curran tells me that there is in the living fish "over the eye a crescent-shaped area coloured reddish like metallic copper"; that the opercles "are metallic gold and green," and that the sides are irradiated with "peacock hues." As to its habits he reports it as being "very sprightly and lively," and hiding cunningly under stones or in holes in the bank when pursued; also that it leaps to the fly, and

can be easily caught in this way." "I saw some stockmen amusing themselves in this manner, the whole outfit consisting of a piece of black thread, a bent pin, and a fly."

Distribution :—Streams and tarns on Mount Kosciusko and the neighbouring uplands, including the head waters of the Snowy River and its tributary, the Crackenback, where they were obtained by Messrs. Curran and Hedley. Later on the former gentleman obtained specimens from the streams draining the northern and western slopes of Kosciusko and flowing into the Murrumbidgee. Spawning in February.

Eleven specimens measuring from 63 to 105 millimeters, were utilised in drawing up the above description.

Appended is a list of the species of *Galaxias* at present known, arranged in chronological order :—

1801. *alepidotus*, Forster, Bloch and Schneider, Syst. Ichth. p. 395; New Zealand.

1817. *truttaceus*, Cuvier, Règne Anim. ii. p. 283; Tasmania and Victoria.

1842. *fasciatus*, Gray, Zool. Misc. p. 73; New Zealand.

1842. *maculatus*, Jenyns, Zool. Beagle, Fish. p. 119, pl. xxii. f. 4; Patagonia, Tierra del Fuego.

1842. *alpinus*, Jenyns, l.c. p. 121; Alpine Lakes of Hardy Peninsula, Tierra del Fuego.

1842. *attenuatus*, Jenyns, l.c. pl. xxii. f. 5; New Zealand, Tasmania, Victoria, Falkland Islands, Western South America northwards to Peru.

1846. *scriba*, Cuvier and Valenciennes, Hist. Nat. Poiss. xviii. p. 347; Port Jackson, New South Wales.

1864. *gracillimus*, Canestrini, Arch. Zool. Anat. e Fisiol. iii. p. 100, pl. iv. f. 2; Chili.

1866. *ocellatus*, McCoy, Intern. Exh. Ess. p. 14; River Yarra, Victoria.

1866. *olidus*, Günther, Catal. Fish. vi. p. 209; New Zealand.

1866. *krefftii*, Günther, l.c. p. 211; New South Wales.

1866. *punctatus*, Günther, l.c. p. 213; New South Wales.

1866. *brevipinnis*, Günther, l.c.; New Zealand.

1867. *waterhousei*, Krefft, Proc. Zool. Soc. Lond. p. 943; South Australia.

1869. *schomburgkii*, Peters, Monatsb. Ac. Wiss. Berlin, 1868. p. 455; Adelaide, South Australia.

1872. *rostratus*, Klunzinger, Arch. f. Nat. p. 41; Murray River.

1872. *versicolor*, Castelnau, Proc. Zool. Soc. Vic. i. p. 176; Marsh near St. Kilda, Victoria.

1872. *cylindricus*, Castelnau, l.c. p. 177; Lower Yarra, Victoria.

1872. *delicatulus*, Castelnau, l.c. p. 178; River Yarra, Victoria.

1872. *amœnus*, Castelnau, l.c.; River Yarra, Victoria.

1873. *ornatus*, Castelnau, l.c. p. 153; Cardinia Creek, Victoria.

1880. *campbelli*, Sauvage, Bull. Soc. Philom. (7) iv. p. 229; Campbell Island.

1880. *coxi*, Macleay, Proc. Linn. Soc. N. S. Wales, 1880, v. p. 45; Mount Wilson, New South Wales.

1881. *coppingeri*, Günther, Proc. Zool. Soc. Lond. p. 21; Alert Bay, Straits of Magelhaen.

1881. *planiceps*, Macleay, l.c. vi. p. 233; Rankin's Lagoon, Bathurst; New South Wales.

1881. *bongbong*, Macleay, l.c.; Mossvale and rivers at Bongbong; New South Wales.

1881. *nebulosa*, Macleay, l.c. p. 234; Long Bay, Sydney, New South Wales.

1882. *findlayi*, Macleay, l.c. vii. p. 107; Streams on Mount Kosciusko, New South Wales.

1882. *auratus*, Johnston, Proc. Roy. Soc. Tas. p. 131; Great Lakes, Tasmania

1882. *weedoni*, Johnston, l.c.; Mersey River, Tasmania.

1882. *atkinsoni*, Johnston, l.c.; Pieman River, Tasmania.

1886. *kayi*, Ramsay and Ogilby, Proc. Linn. Soc. N. S. Wales (2) i. p. 6; Fifth Creek, Adelaide, South Australia.

1888. *indicus*, Day, Fish. Ind. Suppl. p. 806, fig.; Littoral districts of Bengal and Madras.

1892. *nigothoruk*, Lucas, Proc. Roy. Soc. Vic. (2) iv. p. 28; Lake Nigothoruk, Gippsland, Victoria.

1894. *capensis*, Steindachner, Ichth. Beitr. (xvii.) p. 18; Lorenz River, South Africa.

There can be little doubt that many of the species, 32 in number, here catalogued are merely nominal, but, though detailed descriptions of each would doubtless prove of great assistance in indicating the various degrees of affinity which connect the local forms with their antarctic progenitors, it is plainly impossible to even approximately delimitate the species in a satisfactory manner, until a full series of each variety or subspecies shall have been brought together for examination. The local variations in the same form inhabiting the same little subalpine runlets is shown to be so great, as is manifest by the study of the present species, that the wonder is, not that so many nominal species have been created, but that there are not infinitely more.

This perplexing number of local varieties finds its analogue in the common Brook Trout of the North of Ireland,* where every angler is well aware that the Trout from each stream differ so greatly in outward appearance from those inhabiting the next,

* I only mention this locality because it was there that I observed the local differences in *Salmo fario*, but no doubt sportsmen from other districts can testify to the accuracy of the above remarks. Salmon also vary much in different rivers, and even when taken in nets set in the sea many miles from the mouths of the rivers in which they spawn, the individuals belonging to each water way can be unhesitatingly selected (*vide* Ogilby, Proc Roy. Dublin Soc. 1885, p. 526).

that, to any one who knows the waters, the fish from any given stream may be selected at a glance from those of a dozen other streams, but no one now-a-days would venture to assert that they were of different species, even were it not well known that on being transferred from one stream to another the colonists soon assume the characteristics of the local race.* These variations are attributable (in both genera, *Galaxias* and *Salmo*) to similar local causes, such as the depth, stillness or rapidity of the water, the quality and the supply of food, the character of the bottom, the composition of the water, &c.; indeed as to the latter trout taken from streams fed from limestone springs are as different from those residing in waters which have their origin in peat mosses as *Galaxias truttaceus* is from *G. attenuatus*.

As to the affinities of the species, it is useless in the present state of our knowledge to attempt any generalisation, and it is only by obtaining a series of specimens from the localities whence they were originally described that such species as Castelnau's and (in a less degree) Macleay's can be with certainty identified; nevertheless the following corrections and suggestions may be of use :—

Galaxias olidus, Günth., doubtfully attributed by that author to Queensland, proves to be a New Zealand species, and must be erased from the number of Australian fishes.

Galaxias waterhousei, Krefft, is a variety of *G. attenuatus* according to Klunzinger, as is also *G. obtusus*, Klunz. (Sitzb. Ak. Wiss. Wien, 1879, lxxx. i. p. 412). I mention this latter fact because Lucas includes both *attenuatus* and *obtusus* in his "Census of Victorian Fishes, 1889";† although Klunzinger had himself pointed out his own error (*l.c.*), while he omits *truttaceus* which that author had received from "Port Phillip." G. *schomburghii*, Peters, and G. *hayi*, R. and O. are possibly varieties of *Waterhousei*.

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* This does not apply with equal force to the anadromous Salmonids.

† Proc. Roy. Soc. Vic. 1889, pp. 15-47.

Galaxias nebulosa, Macleay, is probably the same as *G. scriba*, Val. The variation in the number of the dorsal and anal rays cannot be considered of any value in this genus if the small unarticulated anterior rays be included, the number of these being extremely inconstant; there is no other character of sufficient consequence to warrant their separation except the size of the eye, which is stated by Valenciennes to measure "two-fifths of the length of the head," a proportion which is quite unknown among the members of the genus, and is very unlikely to be correct. *G. rostratus*, Klunz., should also be compared with *scriba*.

Galaxias auratus, Johnston. Through the courtesy of Mr. Alexander Morton of the Tasmanian Museum, I have had an opportunity of examining two fine examples—225 and 185 millimeters in length—of the form inhabiting the Great Lakes, Tasmania, which lie at an altitude of 4000 feet above the sea level. These specimens I believe to be mere varieties of *G. truttaceus*, modified by their surroundings.

Galaxias indicus, Day. From the first I looked with distrust on the possibility of the occurrence of a species of this genus in Indian waters, and I am, therefore, pleased to find that Dr. Gill not only shares that distrust, but has had the courage to publish his disbelief (Nature, liii. p. 366). Should the species on further examination prove to be a true *Galaxias*, its presence in the Indian littoral would seriously interfere with the theory of an antarctic origin for these fishes.

It will be observed that no less than seven species (*truttaceus*, *attennatus*, *ocellatus*, *versicolor*, *cylindricus*, *delicatulus*, and *amœnus*) are said to be resident in or in the immediate neighbourhood of the Yarra, and since the two first are well known to be of wide distribution and variable appearance I must be permitted to doubt the specific value of all or most of the residual forms, for none of which have their authors pointed out such distinctive characters as would enable one, from a study of the descriptions alone, to determine their specific value. Too much

importance has evidently been placed by Australian authors (I might perhaps with equal truth say by all authors) on the shape and colour of these fishes, both of which characters I have shown above to be quite worthless in distinguishing the species.

Finally I am not satisfied, notwithstanding my scepticism with regard to the number of Australian species, to accept as proved the identity of the New Zealand and Tasmanian *attenuatus* with the Falkland Island and Peruvian form, referred to by Günther under the same name, nor am I prepared to go as far as Macleay in considering that "it is more than probable that they"—all the known forms of *Galaxias*—"are one and all only permanent local varieties of the same fish."